CLAIMS

What is claimed is:

1. A pixel-registered photo detector array comprising:

one or more detector layers of semiconductor material, each detector layer between contact layers of semiconductor material, thereby defining a stack of layers having a front side and a back side; and

a waffle-type light-coupling grating formed on the backside of the stack, the grating having a pattern of holes that reflects a substantial portion of light coming into the array so as to disperse that light through the one or more detector layers, thereby facilitating absorption.

2. The array of claim 1 wherein the pattern of the waffle-type light-coupling grating has a geometry optimized for a center wavelength of interest, and an orientation ranging from about 20 to 70 degrees.

3. The array of claim 2 wherein the geometry includes a hole depth of about one quarter wavelength of the center wavelength of interest, and a spacing between the holes of about the center wavelength of interest.

4. The array of claim 2 wherein the orientation is about 45 degrees.

5. The array of claim 1 wherein the array has a plurality of detector layers, each having a different light absorption versus wavelength response curve thereby enabling a multicolor photo detector.

6. The array of claim 1 wherein edges of the one or more detector layers are reflectively coated so as to provide, in conjunction with the waffle-type light-coupling grating, a photon-in-a-box configuration for containing light within each pixel of the array.

7. The array of claim 1 wherein the waffle-type light-coupling grating includes a hybrid metal layer having both ohmic and reflective qualities.

8. The array of claim 1 wherein each of the one or more detector layers is about one micron or less in thickness.

9. The array of claim 1 wherein each of the contact layers is electrically coupled to a respective electrical contact on the backside, thereby facilitating hybridization where the array is connected to a substrate configured with supporting electrical circuitry.

10. The array of claim 1 wherein the array is configured as a strained-InGaAs/AlGaAs QWIP structure having a limited number of quantum wells so as to enable exploitation of avalanche effects.

11. A pixel-registered photo detector array comprising:

one or more detector layers of semiconductor material, each detector layer between contact layers of semiconductor material, thereby defining a stack of layers having a front side and a back side;

a light-coupling grating formed on the backside of the stack with a hybrid metal layer having both ohmic and reflective qualities, and having a pattern that reflects a substantial portion of light coming into the array so as to disperse that light through the one or more detector layers, thereby facilitating absorption;

wherein edges of the one or more detector layers are reflectively coated so as to provide, in conjunction with the light-coupling grating, a photon-in-a-box configuration for containing light within each pixel of the array.

12. The array of claim 11 wherein the pattern of the light-coupling grating is a waffle-type grating and has a geometry that includes a hole depth of about one quarter wavelength of a center wavelength of interest, and a spacing between the holes of about the center wavelength of interest.

13. The array of claim 11 wherein the pattern of the light-coupling grating has an orientation of about 45 degrees.

14. The array of claim 11 wherein the array has a plurality of detector layers, each having a different light absorption versus wavelength response curve thereby enabling a multicolor photo detector.

15. The array of claim 11 wherein each of the one or more detector layers is about one micron or less in thickness.

16. The array of claim 11 wherein each of the contact layers is electrically coupled to a respective electrical contact on the backside, thereby facilitating hybridization where the array is connected to a substrate configured with supporting electrical circuitry.

17. A pixel-registered photo detector array comprising:

one or more detector layers of semiconductor material, each detector layer between contact layers of semiconductor material, thereby defining a stack of layers of a multicolor photo detector having a front side and a back side;

a rotated light-coupling grating formed on the backside of the stack, the light-coupling grating having a pattern that reflects a substantial portion of light coming into the array so as to disperse that light through the one or more detector layers, thereby facilitating absorption.

18. The array of claim 18 wherein the rotated light-coupling grating has an orientation of about 45 degrees, and has one of a waffle-type or post-type pattern.

19. The array of claim 18 wherein the light-coupling grating includes a hybrid metal layer having both ohmic and reflective qualities, and edges of each detector layer are reflectively coated so as to provide, in conjunction with the light-coupling grating, a photon-in-a-box configuration for containing light within each pixel of the array.

20. The array of claim 18 wherein the array is configured as a strained-InGaAs/AlGaAs QWIP structure having a limited number of quantum wells so as to enable exploitation of avalanche effects.